Safe Transport of Radioactive Material—A Training Experience

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Whilst this is the 9th International Symposium on Packaging and Transportation of Radioactive Materials (PATRAM) and has been publicized as the forum for exchange of technical information on the packaging and shipment of radioactive materials, hitherto there has been scant reference to training in either packaging or shipment. Although past meetings of PATRAM have included developments not only in container and packaging techniques but also in safety, there has been little included on training in safe practices. Moreover, internationally agreed regulations have been developed and adjusted to reflect new standards of science and technology and changing needs, many of which have been identified at previous PATRAM meetings. However, both the packaging and the transportation of radioactive materials can have many vested interests. They can, for example, be an embarrassment, they can be resource-intensive, they can be time-consuming, they can also be turned to commercial advantage; but regardless of motive the very nature of the cargo - - radioactive material - requires the consignee and the carrier to be diligent. Diligent for the sake of the employees of consignee and carrier alike, for the sake of the public and for the sake of the environment, whenever any such radioactive material is moved from one location to another.

A number of the measures necessary to safeguard the public and the environment during the transportation of radioactive materials are obvious, even to the layman; however, others are more subtle, even for the expert and some formal training is essential to provide an understanding of the vicissitudes of this specialized transportation.

Whether the nuclear material be transported by road, rail, sea or air, there are national and international recommendations and conventions supported by legislation in many areas. Training is necessary to comprehend the statutory and advisory nature of these requirements. The International Atomic Energy Agency has published a number of detailed documents to guide those involved with the transport of radioactive benefit from this documentation.

There is the philosophy of radiation protection and the "as low as reasonably achievable, economic and social factors being taken into account" (ALARA) principle, which must be fully understood. There are the various categories of radioactive material that have been identified internationally - those with low specific activity and those surface contaminated objects, for example. The various types of package that have been accepted internationally in which radioactive material may be transported and the concept of activity limits must be constantly in the thoughts of those who have any responsibility for the packaging and transportation of radioactive materials. The design philosophy for the types of package and their quality assurance and the methods of insurance and inspection are important facets that should be comprehended. The nature of the tests conducted to check the integrity of the containment and the shielding, and the regulatory requirements for such

tests should be understood. Training can provide the means by which the required understanding and comprehension can be grasped.

One must consider the physical processes of preparing various categories of nuclear materials for transportation: the packaging of the material and its encapsulation or containment; the packaging itself has to be chosen - within the nuclear power industry, for example, a box for new fuel, a drum for enriched fuel or a flask for irradiated fuel; labelling the package and the appropriate placarding for it must be carefully identified whether the material be transported by road, rail, sea or air; the arranging of insurance and the completion of the paperwork demand that the practitioner is fully aware of his responsibilities, as well as having the dexterity to undertake these tasks. Training is the only sure way to achieve the successful completion of all the processes and tasks identified above.

Besides the preparation of radioactive material for transport and its safe packaging to comply with national and international regulations, there is its actual movement from one location to another - its transportation. The responsibilities of consignor and carrier for the control of material in transit, the idea of a Transport Index, the stowage of packages and what to do with those that are undelivered; all are practicalities that the personnel involved have a moral as well as a statutory obligation to address. Training is essential, not only to meet the requirements of the control of radioactive material in transit, but to maintain the credibility of the personnel responsible.

Then there are comprehensive schemes to cope with people, plant and situations in the event of incidents. The general accident provisions - contingency plans such as the National Arrangements for Incidents involving Radioactivity (NAIR) and the Irradiated Fuel Transport Flask Emergency Plan are applied in the United Kingdom, but similar provisions should exist in every country where the transport of radioactive material is envisaged. Training is imperative if the safety of the public and the environment is to be assured at all times in such circumstances.

Training is thus a key component in the packaging and transportation of radioactive materials. The remainder of this paper offers a method by which suitable training may be provided. It is based on experiences of organizing and managing an international course in England during the autumn of 1987 for the International Atomic Energy Agency (IAEA) on Safe Transport of Radioactive Material and in spite of its title, packaging was also included as can be seen from a copy of the programme, which is available from the author on request. Accordingly, experiences of the course are usefully shared here as they will enable others contemplating the provision of training in this topic to gain from the lessons learned.

The training course, of three weeks' duration, was hosted by the Central Electricity Generating Board (CEGB) at its Nuclear Power Training Centre on behalf of the British Government under the IAEA Interregional Training Programme; the Agency offers a scheme to provide technical support and information for developing nuclear nations, which are member states of this Agency of the United Nations.

As the CEGB had been invited by the IAEA to take responsibility for the organization of the course, a Systems Approach to Training (Fig 1) was followed, in keeping with the Board's nuclear training policy. A small panel was established under the direction of a training manager from the CEGB Nuclear Power Training Centre comprising the following individuals: a technical expert from the Agency (whose normal duties included specific responsibility in Vienna for the international guidelines, safe practices and technical documentation regarding the safe transport of radioactive material); a technical adviser from the Department of Transport (DTp) (whose normal duties included responsibility in the UK for giving approval for transportation of radioactive material); a Senior Tutor from the CEGB Nuclear Power Training Centre (whose normal duties included lecturing and writing documentation on health physics, radiological protection, radioactivity and safe practices required to handle and transport radioactive substances); the Specialist Training Engineer from the CEGB (whose normal duties included responsibility for all nuclear specialist technology courses at its Nuclear Power Training Centre). The latter panel member acted as

Course Manager throughout the design, development and implementation stages of the course, having had the additional experience of working in developing nuclear nations and of organizing and managing other international courses for the CEGB in conjunction with IAEA. This panel, in designing the course, also drew on expertise from elsewhere besides IAEA, DTp and CEGB.

In adhering to the Systems Approach to Training, the panel decided that the IAEA documentation (the Safety Standards, Safety Guides, and Technical Documents) should form the framework for the participants' ultimate knowledge. It was agreed that a thorough familiarization of the published material from Vienna should be the goal for all the participants, coupled with practical experience of dealing with radioactive material to enable them to handle it safely; this would enable them to package and transport (or be responsible for the movement of) such material safely, not only within their own national boundaries but also across international frontiers by road, rail, sea and air. This stage was regarded as an analysis of the jobs or responsibilities of the participants.

The next stage in the Systems Approach to Training is to examine the background of the potential learners. In practice, this was achieved by the training experts of IAEA and CEGB jointly determining the minimum academic and technical backgrounds that the participants should have, publicizing these standards and selecting the participants accordingly.

Having thus fixed the ultimate goals in the first stage and the initial backgrounds in the second stage, the difference between these two identified the training to be provided. At this stage the panel had to make some pragmatic decisions rather than act as idealistic training course designers. Certain aspects of the deficiencies between the goals for the participants and their backgrounds could not realistically be provided by attending a course - whatever its duration - at the Nuclear Power Training Centre. It was decided, therefore, that the aims of the course should be to provide a thorough familiarization of the IAEA Safety Series relating to the Safe Transport of Radioactive Material, viz 6, 7, 37 and 80, and an understanding of the reasons for the regulations embodied in these. It was further decided to address the associated skills required to implement the regulations, illustratively only, as hands-on training would have been impracticable. After the panel had focussed on the general aims of the course the next stage was to discuss how they should be met by deciding the macro training objectives - the framework by which the aims could be met.

Thus a programme was designed, elaborated further below, during which stage the format of the course was chosen. There were to be formal presentations, panel discussions, participative exercises, demonstrations, and visits to relevant locations around the United Kingdom. The panel was mindful that the Agency and the CEGB wanted some indications, even assurance, that the course and the training had been effective. Thus it was felt desirable to have a means of evaluating the course and of assessing the participants not necessarily formally but certainly in a structured way. Another consideration that the panel took cognizance of was that the course was to be conducted in English, probably not (and in the event definitely not) the mother tongue of any participant. Time, therefore, had to be allocated within the training programme for clarification of terminology to cope with language problems as well as those of a technical nature. Another dimension, which the training experts of the panel drew to the attention of the technical experts, was that training course design can be, in fact should be, quite different from technical conference design. Course sessions, of necessity, must be structured quite differently from conference papers; for example, allowance was made for dialogue between speaker and participant within each presentation; opportunities were provided to revisit issues requiring elaboration; tutorial assistance was made available when needed.

It was only after the panel had produced a draft programme, identified potential speakers and had discussed the aims and objectives of each session with them that it became apparent that the course would take three weeks. At this stage a member of the Administration group at the Nuclear Power Training Centre joined the panel to deal with the very demanding "behind the scenes" backup essential for the smooth running of a course - particularly one of an international nature. It was agreed, for example, that every session would benefit from handouts and that these should all be provided for the participants at the commencement of the course. Speakers had to be encouraged

to prepare draft texts for typing well in advance of the course to enable the CEGB Tutor to check them for uniformity - and several speakers required a great deal of encouragement. There was no logical reason for the reticence of speakers to write handouts except departure from the traditional "last minute" committing of thoughts - however logical - to paper. In practice the availability of macro- objectives proffered viable headings around which the handouts could be written.

To follow the Systems Approach to Training rigidly, the organizers should have staged a pilot course with surrogate participants to validate the proposed programme. Improvement or modifications could then have been incorporated to any part of the design stage choice of objectives, choice of format, method of evaluation, etc. In the event it was impracticable to mount a pilot course and the validation/modification became a paperwork exercise. Nevertheless, this step was undertaken to ensure that "it would be all right on the night."

The procedures outlined above provided the method by which this course was designed and in the event its implementation was a great success, with compliments being poured over organizers and speakers alike. In fact gratitude is still being expressed by the participants from thousands of miles distant and after several months have elapsed. But what did we teach them while they were with us at the Nuclear Power Training Centre? What was the content of the training course?

The course, as already intimated, was built around the IAEA Safety Series 6, 7, 37, and 80 and the supporting Technical Documents. However, when the organizing panel first met there were two editions of Safety Series 6 in circulation, Safety Series 7 was being rewritten and several Technical Documents were half-written. It was decided to refer to the 1985 Edition of Safety Series No. 6 throughout the course and to provide every participant with copies of the Safety Series. As a number of the participants were working in Latin America it was convenient to give them copies of Safety Series No. 6 in the Spanish language. Other participants were more comfortable reading French than English and so we gave them Safety Series No. 6 published in French. Unfortunately (for the participants) the Technical Documents were available only in English; nevertheless, these were issued as part of the course documentation. As a principle, the paragraph headings in the booklets were used as the substance of a teaching session or series of sessions.

Early during the planning stage of the course, it became evident that, with the quite diverse considerations for the safe transport of radioactive material, some coherence had to be introduced. Accordingly six examples of radioactive material were identified as follows:

a) uranium ore and concentrates, uranium hexafluoride and new fuel

b) low level radioactive wastes

c) spent fuel

d) radioisotopes - such as technetium generators

e) sources used for non-destructive testing

f) excepted materials.

During the course, reference was made, wherever sensible, to these six examples.

For some considerations (categories of radioactive material) the six examples could be grouped together in one way, but for other considerations (types of packages, or activity limits, or administrative procedures, or insurance) the six examples could be grouped differently. Notwithstanding, these examples provided a useful and recognizable theme throughout the course.

It was further decided that the first part of the training should concentrate on the IAEA documentation with the lecturers highlighting particular aspects and clarifying any issues in the

documentation that the participants may wish to raise. It was, therefore, essential that potential speakers should be thoroughly conversant with the information and, where possible, have been involved in the original preparation of such IAEA material. The IAEA Technical Expert in Vienna, and indeed his predecessor, were accordingly invited to make presentations early in the course. Having planned to set the scene by elaborating on the content of the Safety Series, the organizing panel felt that subsequent presentations should reflect experiences of applying the guidance in the practical world. As the participants were from developing nuclear nations, or Member States of the Agency where the packaging and transport of radioactive material was in its infancy, it was appropriate to include lecturers with wide expertise, encompassing the packaging, transportation, and licensing or regulation of such. Thus, speakers came not only from the United Kingdom and countries with a major nuclear interest, such as France and Germany, and countries with vast distances to consider such as the United States of America, but those with experience in a country having a relatively small nuclear involvement such as Finland. The participants could, therefore, benefit not only by listening to practitioners expounding the virtues and merits of the international requirements but by hearing from first hand experience the benefits, and any difficulties, of their practical application in a variety of countries. However, such an information exchange was not merely one way and the added bonus of staging a course such as this, was for the national and international experts to learn of problems the participants had discovered in interpreting and implementing the IAEA documentation. As many of these experts were chosen because of their involvement with the production and revision of IAEA material they were admirably placed after the conclusion of our course to consider the situations drawn to their attention by the participants.

As the organization for the course in the United Kingdom lay primarily with CEGB, it was considered desirable that the course itself should not be flavored too strongly with Generating Board attitudes, however commendable. Accordingly other bodies with nuclear interests were involved with presentations such as Amersham International plc, British Nuclear Fuels plc, the Atomic Energy Authority, United Kingdom Nirex Ltd, the National Radiological Protection Board, and the Nuclear Installations Inspectorate. Whilst not having a primary interest in nuclear matters the Civil Aviation Authority, and the International Maritime Organization (which has its headquarters in London and is yet another Agency of the United Nations), are very much involved with safe practices in transporting radioactive material, as is the Department of Transport. Potential speakers from all these organizations were contacted and involved at an appropriate stage in the Systems Approach to Training. All those who agreed to make presentations were suitably briefed and exhorted to supply drafts of their handouts well in advance of the course. Assistance was made available from the CEGB Nuclear Power Training Centre in the composition and preparation of visual aids to accompany the presentations, in addition to the editing and typing of the handouts discussed above.

Other organizations in the United Kingdom deeply interested in transportation for the nuclear industry were approached. Securicor and British Airways not only provided speakers but acted as munificent hosts in West London to demonstrate how they each enact the IAEA regulations. Croft Associates Ltd, a UK firm offering advice on specialized packaging and transportation, also provided an authoritative speaker. At the Structural Test Centre at Cheddar, CEGB engineers described the facilities and services available there to carry out drop tests and various integrity tests on Type A and Type B packages. The participants on the course were privileged to witness a drop test on a 1/4 scale model of a Magnox Irradiated Fuel Element Transport Flask. The Course Manager welcomed this demonstration as being far more illuminating than seeing a film of a typical test.

To promote the heuristic element of the course, a number of participative exercises were devised by the organizing panel requiring the participants to work in groups of four at specified points during the course. The composition of each group was determined by the Course Manager after two weeks had elapsed, enabling him to assess the personality, compatability, and language fluency of each participant. The numbers were such that three pairs of groups acted the role of consignor/carrier whilst the other three pairs behaved as the competent - authority/regulatory - body/compliance - assurance team. All groups were given imaginary conditions (details from the

author), under which certain radioactive material had to be transported. The roles were then changed and other conditions considered. At the end of the third week of the course a spokesman from each group made a presentation to the other participants of the findings of that group. This technique not only ensured that the participants immersed themselves in the course but the exercises were carefully chosen to cause the participants to constantly refer to the IAEA documents; they were asked to quote paragraph and section numbers in their presentations which made them thoroughly familiar with the content of the IAEA publications.

These participative exercises brought an additional advantage during the presentations made towards the end of the course by the participants. It enabled the Course Manager and the technical experts from Vienna and the Department of Transport to evaluate the effectiveness of the course and, to a certain extent, assess the understanding by the participants of the material they had been taught. A questionnaire was also completed by each participant to provide the organizers with further information on the quality of the training provided. The subsequent high quality of the presentations by the participants and the results of the questionnaires can be interpreted only in terms of the course being successful.

Towards the end of the design stage of this course, an indication was given of the potential high esteem in which this course was likely to be held. Mr Noramly bin Muslim, a Deputy Director General of the IAEA and at the time Acting Director General, expressed the desire to attend during the presentations of the participative exercises at the conclusion of the course. In the event his presence and concluding address demonstrated that this course had provided a valuable contribution to the Packaging and Transportation of Radioactive Materials.

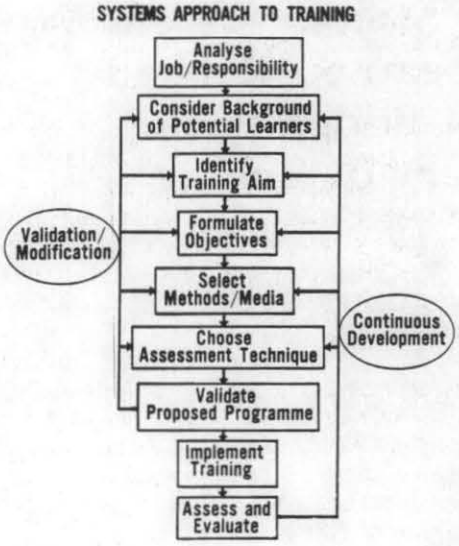

Fig 1. Systems Approach to Training - Comprehensive Model

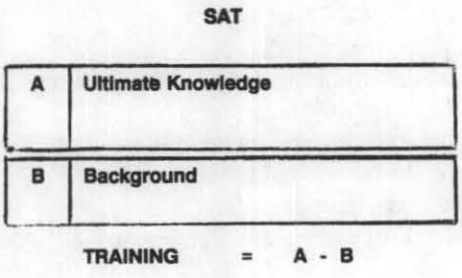

Fig. 2. Systems Approach to Training - Simplified Model

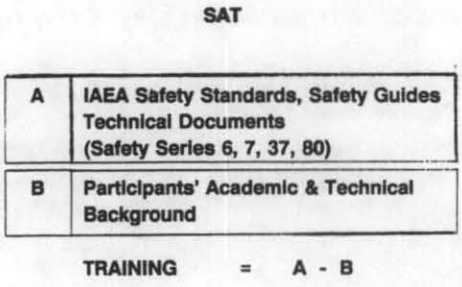

Fig. 3. Systems Approach to Training - Model Applied to CEGB Course